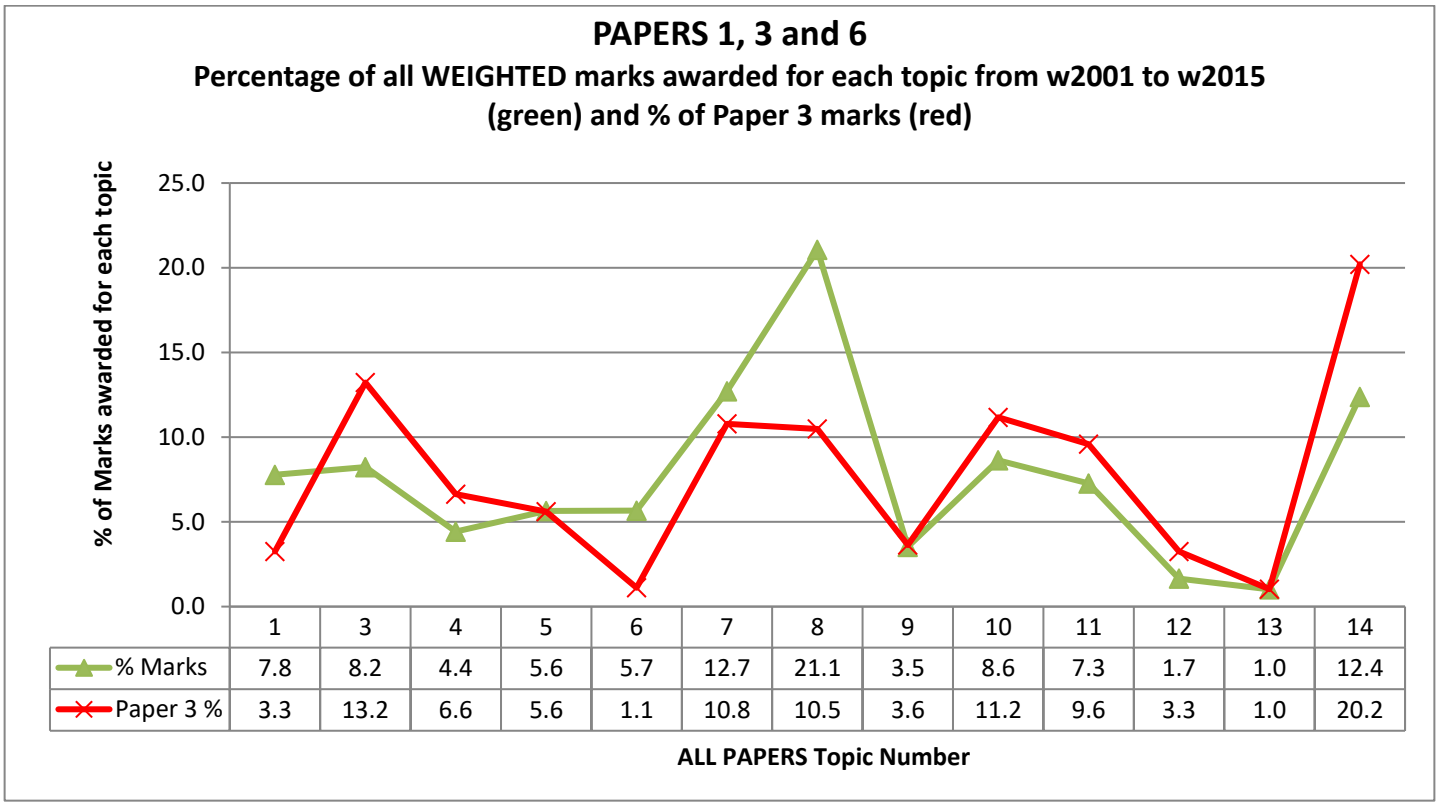
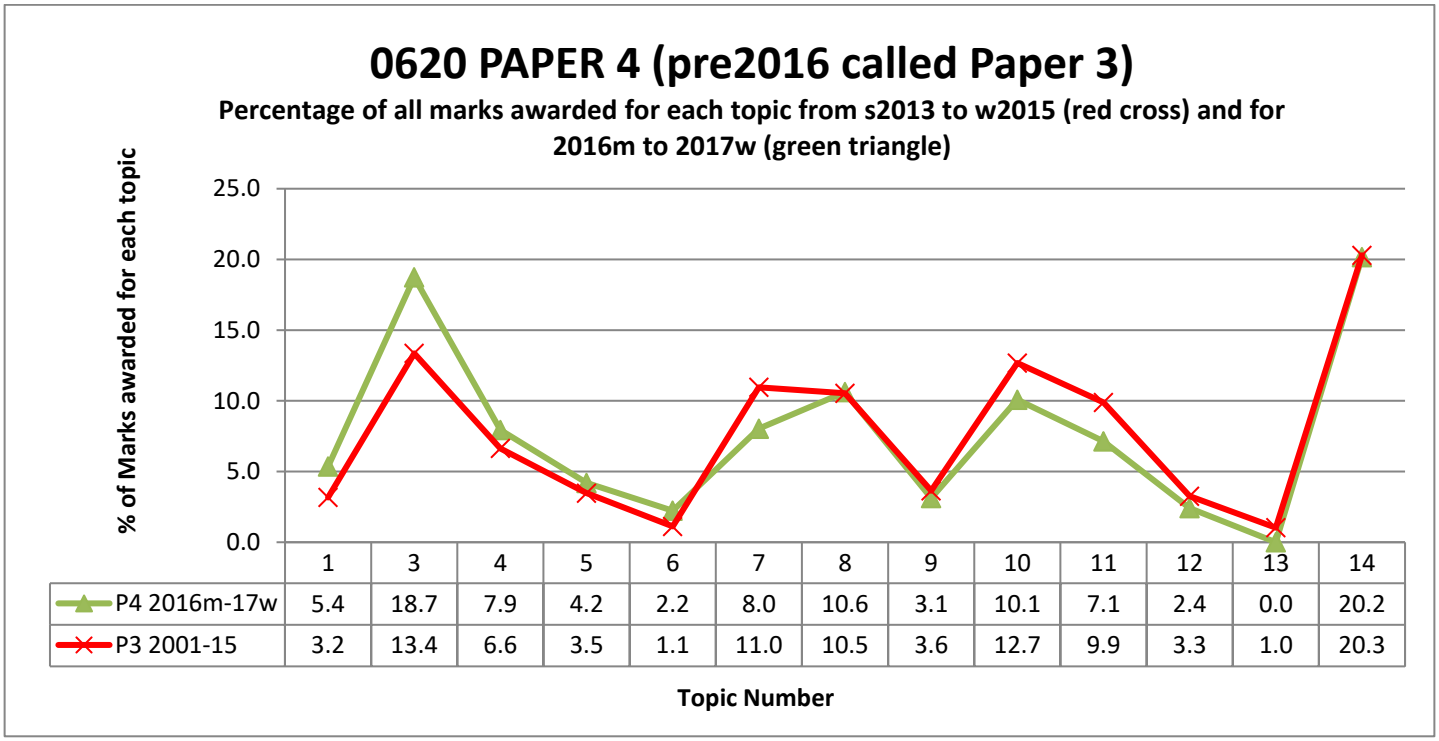
iG Chem 4 EQ P3 15w to 01s 4Teachers NEW 155marks



	1	3	4	5	6	7	8	9	10	11	12	13	14
% Marks	7.8	8.2	4.4	5.6	5.7	12.7	21.1	3.5	8.6	7.3	1.7	1.0	12.4
Paper 3 %	3.3	13.2	6.6	5.6	1.1	10.8	10.5	3.6	11.2	9.6	3.3	1.0	20.2



	1	3	4	5	6	7	8	9	10	11	12	13	14
P4 2016m-17w	5.4	18.7	7.9	4.2	2.2	8.0	10.6	3.1	10.1	7.1	2.4	0.0	20.2
P3 2001-15	3.2	13.4	6.6	3.5	1.1	11.0	10.5	3.6	12.7	9.9	3.3	1.0	20.3

	Total	Chem 1	Chem 3	Chem 4	Chem 5	Chem 6	Chem 7	Chem 8	Chem 9	Chem 10	Chem 11	Chem 12	Chem 13	Chem 14
Total Marks	2320	74	312	155	81	26	256	246	85	296	231	76	24	474
% of Marks	2336	3.2	13.4	6.6	3.5	1.1	11.0	10.5	3.6	12.7	9.9	3.3	1.0	20.3
# of Questions		19	59	39	18	6	47	54	19	58	48	14	5	80
Average marks per Q		**3.9**	**5.3**	**4.0**	**4.5**	**4.3**	**5.4**	**4.6**	**4.5**	**5.1**	**4.8**	**5.4**	**4.8**	**5.9**

Topic	14	3	10	7	8	11	4	5	9	1	12	6	13
Rank ALL Papers	2	4	5	3	1	6	9	8	11	7	12	10	13
Rank P3: A* Focus	1	2	3	4	5	6	7	8	9	10	10	12	13
All Syllabus Word Count RANK	1	2	5	3	6	4	9	7	10	8	12	11	13

CIE iGCSE Chemistry Syllabus Details (syllabus code 0620)

Throughout this material there will be references to Paper 3, you should assume it is referring to the NEW Paper 4. In 2016 the name changed, but the content essentially did not.

The core material is examined in all three exam papers (papers 1,3 and 6) and is intended to assess understanding up to a grade C level. From 2016, the Supplement material is now also examined in NEW Paper 2 (old paper 1) as well as NEW Paper 4 (old paper 3).

1. Paper 4 (old 3) will contain fewer Supplement marks, so more core marks so ought to be easier (if you can answer the Paper 3 questions from before 2016 then you will be fine)
2. Paper 2 will contain Supplement marks, unlike in all papers before 2016, so will assess material they have not done before, so will be harder because of the questions
3. Syllabus material below that is new or changed in 2016 is highlighted with BLACK LINES next to it.

4. Stoichiometry	
4.1 Stoichiometry **Core** • Use the symbols of the elements and write the formulae of simple compounds • Deduce the formula of a simple compound from the relative numbers of atoms present • Deduce the formula of a simple compound from a model or a diagrammatic representation • Construct word equations and simple balanced chemical equations • Define *relative atomic mass*, A_r, as the average mass of naturally occurring atoms of an element on a scale where the ^{12}C atom has a mass of exactly 12 units • Define *relative molecular mass*, M_r, as the sum of the relative atomic masses (*Relative formula mass* or M_r will be used for ionic compounds.) (Calculations involving reacting masses in simple proportions may be set. Calculations will **not** involve the mole concept.)	**Supplement** • Determine the formula of an ionic compound from the charges on the ions present • Construct equations with state symbols, including ionic equations • Deduce the balanced equation for a chemical reaction, given relevant information
4.2 The mole concept	**Supplement** • Define the *mole* and the *Avogadro constant* • Use the molar gas volume, taken as 24 dm^3 at room temperature and pressure • Calculate stoichiometric reacting masses, volumes of gases and solutions, and concentrations of solutions expressed in g/dm^3 and mol/dm^3 (Calculations involving the idea of limiting reactants may be set. Questions on the gas laws and the conversion of gaseous volumes to different temperatures and pressures will **not** be set.) • Calculate empirical formulae and molecular formulae • Calculate percentage yield and percentage purity

Q# 1/ iGCSE Chemistry/2015/w/Paper 31/

5 **(a)** A compound, **X**, contains 55.85% carbon, 6.97% hydrogen and 37.18% oxygen.

(i) How does this prove that compound **X** contains only carbon, hydrogen and oxygen?

..... [1]

(ii) Use the above percentages to calculate the empirical formula of compound **X**.

..... [2]

(iii) The M_r of **X** is 86.

What is its molecular formula?

..... [2]

Q# 2/ iGCSE Chemistry/2015/s/Paper 31/ Q3

(d) Calculate the maximum mass of zinc which will react with 50 cm^3 of hydrochloric acid, of concentration 2.0 mol/dm^3.

$$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$

Show your working.

[3]

Q# 3/ iGCSE Chemistry/2014/s/Paper 31/

6 Hydrogen peroxide decomposes to form water and oxygen. This reaction is catalysed by manganese(IV) oxide.

(d) In the first experiment, the maximum volume of oxygen produced was 96 cm^3 measured at r.t.p. Calculate the concentration of the aqueous hydrogen peroxide in mol/dm^3.

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

number of moles of O_2 formed = ... [1]

number of moles of H_2O_2 in 40 cm^3 of solution = ... [1]

concentration of the aqueous hydrogen peroxide in mol/dm^3 = ...

..... [1]

Q# 4/ iGCSE Chemistry/2013/w/Paper 31/ Q4

(d) Calculate the maximum mass of carbon dioxide given off when 20.0 g of small lumps of calcium carbonate react with 40 cm^3 of hydrochloric acid, concentration 2.0 mol / dm^3.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

number of moles of HCl used =

mass of carbon dioxide = ... g [4]

Q# 5/ iGCSE Chemistry/2013/w/Paper 31/

(c) Basic lead(II) carbonate has a formula of the type $xPbCO_3.yPb(OH)_2$ where x and y are whole numbers.
Determine x and y from the following information.

$$PbCO_3 \rightarrow PbO + CO_2$$

$$Pb(OH)_2 \rightarrow PbO + H_2O$$

When heated, the basic lead(II) carbonate gave 2.112 g of carbon dioxide and 0.432 g of water.

Mass of one mole of CO_2 = 44 g
Mass of one mole of H_2O = 18 g

Number of moles of CO_2 formed = ... [1]

Number of moles of H_2O formed = ... [1]

x = ... and y = ...

Formula of basic lead(II) carbonate is ..... [1]

Q# 6/ iGCSE Chemistry/2013/s/Paper 31/ Q6

Ammonia is/ a compound w/ith the molecular formula NH_3

(c) Another compound which contains only nitrogen and hydrogen is hydrazine, N_2H_4.

Complete the equation for the preparation of hydrazine from ammonia.

$$.....NH_3 + NaClO \rightarrow N_2H_4 + ... + H_2O$$ [2]

Q# 7/ iGCSE Chemistry/2013/s/Paper 31/

3 A small piece of marble, $CaCO_3$, was added to 5.0 cm^3 of hydrochloric acid, concentration 1.0 mol / dm^3, at 25 °C. The time taken for the reaction to stop was measured. The experiment was repeated using 5.0 cm^3 of different solutions of acids. The acid was in excess in all of the experiments.

Typical results are given in the table.

experiment	temperature / °C	acid solution	time / min
1	25	hydrochloric acid 1.0 mol / dm^3	3

(b) The equation for the reaction in experiment 1 is:

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

Complete the following ionic equation.

$$CaCO_3(s) + 2H^+(aq) \rightarrow ..... + ... + ...$$

[1]

Q# 8/ iGCSE Chemistry/2012/w/Paper 31/ Q7

(c) In the above experiment, 50.0 cm^3 of hydrochloric acid of concentration 2.0 mol / dm^3 was used. 6.4 g of $SrCl_2.6H_2O$ was made.
Calculate the percentage yield.

number of moles of HCl used = ...

number of moles of $SrCl_2.6H_2O$ which could be formed = ...

mass of one mole of $SrCl_2.6H_2O$ is 267 g

theoretical yield of $SrCl_2.6H_2O$ = ...g

percentage yield = ...% [4]

Q# 9/ iGCSE Chemistry/2012/w/Paper 31/ Q2

(c) Fluorine, the most reactive halogen, forms compounds with the other halogens. It forms two compounds with bromine.
Deduce their formulae from the following information.

compound 1
The mass of one mole of this compound is 137 g.

Its formula is ..... [1]

compound 2
0.02 moles of this compound contain 0.02 moles of bromine atoms and 0.1 moles of fluorine atoms.

Its formula is ..... [1]

Q# 10/ iGCSE Chemistry/2012/s/Paper 31/

8 Iron and steel rust when exposed to water and oxygen. Rust is hydrated iron(III) oxide.

(b) A sample of rust had the following composition:

51.85 g of iron 22.22 g of oxygen 16.67 g of water.

Calculate the following and then write the formula for this sample of rust.

number of moles of iron atoms, Fe = ... [1]

number of moles of oxygen atoms, O = ... [1]

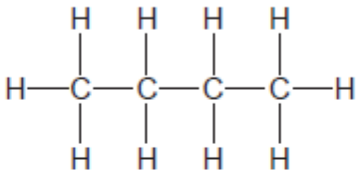
number of moles of water molecules, H_2O = ... [1]

simplest mole ratio Fe : O : H_2O is ..... : ..... : .....

formula for this sample of rust is ..... [1]

Q# 11/ iGCSE Chemistry/2012/s/Paper 31/

6 Butane is an alkane. It has the following structural formula.



(a) The equation for the complete combustion of butane is given below. Insert the two missing volumes.

$$2C_4H_{10}(g) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(g)$$

.... 40 volume of gas / cm^3

[2]

Q# 12/ iGCSE Chemistry/2011/w/Paper 31/ Q7

(c) There are three possible equations for the thermal decomposition of sodium hydrogencarbonate.

$2NaHCO_3(s) \rightarrow Na_2O(s) + 2CO_2(g) + H_2O(g)$ **equation 1**

$NaHCO_3(s) \rightarrow NaOH(s) + CO_2(g)$ **equation 2**

$2NaHCO_3(s) \rightarrow Na_2CO_3(s) + CO_2(g) + H_2O(g)$ **equation 3**

The following experiment was carried out to determine which one of the above is the correct equation.

A known mass of sodium hydrogencarbonate was heated for ten minutes. It was then allowed to cool and weighed.

Results
Mass of sodium hydrogencarbonate = 3.36 g
Mass of the residue = 2.12 g

Calculation
M_r for $NaHCO_3$ = 84 g; M_r for Na_2O = 62 g; M_r for NaOH = 40 g
M_r for Na_2CO_3 = 106 g

(i) Number of moles of $NaHCO_3$ used = ... [1]

(ii) If residue is Na_2O, number of moles of Na_2O = ...

If residue is NaOH, number of moles of NaOH = ...

If residue is Na_2CO_3, number of moles of Na_2CO_3 = ... [2]

(iii) Use the number of moles calculated in **(i)** and **(ii)** to decide which one of the three equations is correct. Explain your choice.

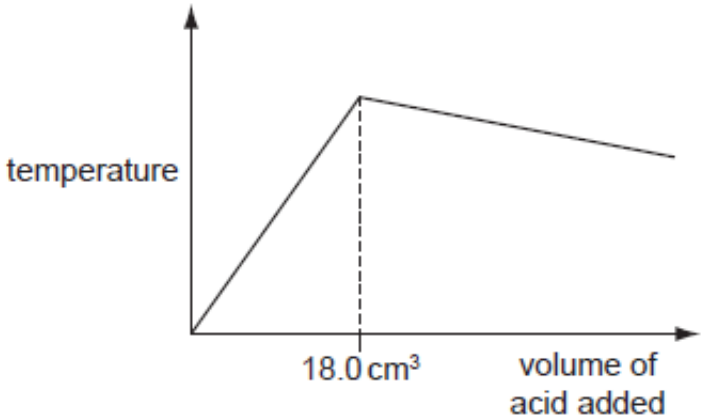
.....

.....

..... [2]

Q# 13/ iGCSE Chemistry/2011/s/Paper 31/ Q5

(d) 20.0 cm^3 of aqueous sodium hydroxide, 2.00 mol / dm^3, was placed in a beaker. The temperature of the alkali was measured and 1.0 cm^3 portions of hydriodic acid were added. After each addition, the temperature of the mixture was measured. Typical results are shown on the graph.



$$NaOH(aq) + HI(aq) \rightarrow NaI(aq) + H_2O(l)$$

(iii) In another experiment, it was shown that 15.0 cm^3 of the acid neutralised 20.0 cm^3 of aqueous sodium hydroxide, 1.00 mol / dm^3. Calculate the concentration of the acid.

.....

..... [2]


SMASHING!!!

Q# 14/ iGCSE Chemistry/2010/w/Paper 31/ Q5

(b) 6.0 g of cobalt(II) carbonate was added to 40 cm^3 of hydrochloric acid, concentration 2.0 mol / dm^3. Calculate the maximum yield of cobalt(II) chloride-6-water and show that the cobalt(II) carbonate was in excess.

$$CoCO_3 + 2HCl \rightarrow CoCl_2 + CO_2 + H_2O$$

$$CoCl_2 + 6H_2O \rightarrow CoCl_2.6H_2O$$

Maximum yield

Number of moles of HCl used = ...

Number of moles of $CoCl_2$ formed = ...

Number of moles of $CoCl_2.6H_2O$ formed = ...

Mass of one mole of $CoCl_2.6H_2O$ = 238 g

Maximum yield of $CoCl_2.6H_2O$ = ... g [4]

To show that cobalt(II) carbonate is in excess

Number of moles of HCl used = ... (use value from above)

Mass of one mole of $CoCO_3$ = 119 g

Number of moles of $CoCO_3$ in 6.0 g of cobalt(II) carbonate = ... [1]

Explain why cobalt(II) carbonate is in excess .....

..... [1]

Q# 15/ iGCSE Chemistry/2010/s/Paper 31/ Q7

(e) The titanium ore contains 36.8% iron, 31.6% titanium and the remainder is oxygen.

(i) Determine the percentage of oxygen in this titanium compound.

percentage of oxygen = ... % [1]

(ii) Calculate the number of moles of atoms for each element.
The number of moles of Fe is shown as an example.
number of moles of Fe = 36.8 / 56 = 0.66

number of moles of Ti = ...

number of moles of O = ... [1]

(iii) What is the simplest ratio for the moles of atoms?

Fe : Ti : O

....

[1]

(iv) What is the formula of this titanium compound?

..... [1]

Q# 16/ iGCSE Chemistry/2009/w/Paper 3/ Q6

(c) 9.12g of anhydrous iron(II) sulfate was heated. Calculate the mass of iron(III) oxide formed and the volume of sulfur trioxide, at r.t.p., formed.

$2FeSO_4(s) \rightarrow Fe_2O_3(s) + SO_2(g) + SO_3(g)$

mass of one mole of $FeSO_4$ = 152g

number of moles of $FeSO_4$ used = ...

number of moles of Fe_2O_3 formed = ...

mass of one mole of Fe_2O_3 = ... g

mass of iron(III) oxide formed = ... g

number of moles of SO_3 formed = ...

volume of sulfur trioxide formed = ... dm^3

[6]

Q# 17/ iGCSE Chemistry/2009/s/Paper 31/

9 Quantities of chemicals, expressed in moles, can be used to find the formula of a compound, to establish an equation and to determine reacting masses.

(a) A compound contains 72% magnesium and 28% nitrogen. What is its empirical formula?

.....

.....

.....

..... [2]

(b) A compound contains only aluminium and carbon. 0.03 moles of this compound reacted with excess water to form 0.12 moles of $Al(OH)_3$ and 0.09 moles of CH_4.

Write a balanced equation for this reaction.

.....

.....

.....

..... [2]

(c) 0.07 moles of silicon reacts with 25g of bromine.

$$Si + 2Br_2 \longrightarrow SiBr_4$$

(i) Which one is the limiting reagent? Explain your choice.

.....

.....

.....

.....

..... [3]

(ii) How many moles of $SiBr_4$ are formed?

..... [1]

Q# 18/ iGCSE Chemistry/2008/w/Paper 31/

4 Across the world, food safety agencies are investigating the presence of minute traces of the toxic hydrocarbon, benzene, in soft drinks. It is formed by the reduction of sodium benzoate by vitamin C.

(b) Benzene contains 92.3% of carbon and its relative molecular mass is 78.

(i) What is the percentage of hydrogen in benzene?

..... [1]

(ii) Calculate the ratio of moles of C atoms: moles of H atoms in benzene.

.....

..... [2]

(iii) Calculate its empirical formula and **then** its molecular formula.

The empirical formula of benzene is .....

The molecular formula of benzene is ..... [2]

Q# 19/ iGCSE Chemistry/2008/w/Paper 31/

3 Steel is an alloy made from impure iron.

(a) Both iron and steel rust. The formula for rust is $Fe_2O_3.2H_2O$.
It is hydrated iron(III) oxide.

(c) (i) Calculate the mass of one mole of $Fe_2O_3.2H_2O$.

..... [1]

(ii) Use your answer to (i) to calculate the percentage of iron in rust.

.....

..... [2]

Q# 20/ iGCSE Chemistry/2008/w/Paper 31/

7 The alkanes are generally unreactive. Their reactions include combustion, substitution and cracking.

(a) The complete combustion of an alkane gives carbon dioxide and water.

(i) 10 cm^3 of butane is mixed with 100 cm^3 of oxygen, which is an excess. The mixture is ignited. What is the volume of unreacted oxygen left and what is the volume of carbon dioxide formed?

$$C_4H_{10}(g) + 6\tfrac{1}{2}O_2(g) \longrightarrow 4CO_2(g) + 5H_2O(l)$$

Volume of oxygen left = ... cm^3

Volume of carbon dioxide formed = ... cm^3 [2]

Q# 21/ iGCSE Chemistry/2008/s/Paper 31/ Q7

(b) Using 25.0 cm^3 of aqueous sodium hydroxide, 2.24 mol / dm^3, 3.86 g of crystals were obtained. Calculate the percentage yield.

$$2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$$

$$Na_2SO_4 + 10H_2O \longrightarrow Na_2SO_4.10H_2O$$

Number of moles of NaOH used = ...

Maximum number of moles of $Na_2SO_4.10H_2O$ that could be formed = ...

Mass of one mole of $Na_2SO_4.10H_2O$ = 322 g

Maximum yield of sodium sulphate-10-water = ... g

Percentage yield = ... % [4]

Q# 22/ iGCSE Chemistry/2007/w/Paper 3/

7 (a) A small piece of marble, calcium carbonate, was added to 5 cm^3 of hydrochloric acid at 25 °C. The time taken for the reaction to stop was measured.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

Similar experiments were performed always using 5 cm^3 of hydrochloric acid.

(b)

(ii) One piece of marble, 0.3 g, was added to 5 cm^3 of hydrochloric acid, concentration 1.00 mol / dm^3. Which reagent is in excess? Give a reason for your choice.

mass of one mole of $CaCO_3$ = 100 g

number of moles of $CaCO_3$ = ...

number of moles of HCl = ...

reagent in excess is .....

reason ..... [4]

(iii) Use your answer to **(ii)** to calculate the maximum volume of carbon dioxide produced measured at r.t.p.

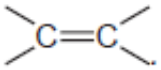
..... [1]

Q# 23/ iGCSE Chemistry/2007/s/Paper 3/ Q7

(d) A better way of measuring the degree of unsaturation is to find the iodine number of the unsaturated compound. This is the mass of iodine that reacts with all the double bonds in 100 g of the fat.

Use the following information to calculate the number of double bonds in one molecule of the fat.

Mass of one mole of the fat is 884 g.

One mole of I_2 reacts with one mole 

The iodine number of the fat is 86.2 g.

Complete the following calculation.

100 g of fat reacts with 86.2 g of iodine.

884 g of fat reacts with ..... g of iodine.

One mole of fat reacts with ..... moles of iodine molecules.

Number of double bonds in one molecule of fat is ..... [3]

Q# 24/ iGCSE Chemistry/2006/w/Paper 3/ Q3

(b) When calcium carbonate is heated strongly, it decomposes.

$$CaCO_3 \rightarrow CaO + CO_2$$

(i) Calculate the relative formula mass of:

$CaCO_3$ .....

CaO ..... [2]

(ii) 7.00 kg of calcium oxide was formed. What mass of calcium carbonate was heated?

.....

..... [2]

Q# 25/ iGCSE Chemistry/2006/w/Paper 3/

6 An ore of copper is the mineral, chalcopyrite. This is a mixed sulphide of iron and copper.

(a) Analysis of a sample of this ore shows that 13.80 g of the ore contained 4.80 g of copper, 4.20 g of iron and the rest sulphur.
Complete the table and calculate the empirical formula of chalcopyrite.

	copper	iron	sulphur
composition by mass/g	4.80	4.20	
number of moles of atoms			
simplest mole ratio of atoms			

[3]

The empirical formula is

..... [1]

Q# 26/ iGCSE Chemistry/2006/s/Paper 3/ Q7

(d) Propene reacts with hydrogen iodide to form 2-iodopropane.

$CH_3–CH=CH_2 \quad + \quad HI \longrightarrow CH_3–CHI–CH_3$

1.4 g of propene produced 4.0 g of 2-iodopropane.

Calculate the percentage yield.

moles of $CH_3–CH=CH_2$ reacted = ...

maximum moles of $CH_3–CHI–CH_3$ that could be formed = ...

mass of one mole of $CH_3–CHI–CH_3$ = 170 g

maximum mass of 2-iodopropane that could be formed = ...

percentage yield ..... % [4]

Q# 27/ iGCSE Chemistry/2005/w/Paper 3/

6 **(a)** The following method is used to make crystals of hydrated nickel sulphate.

An excess of nickel carbonate, 12.0 g, was added to 40 cm^3 of sulphuric acid, 2.0 mol/dm^3. The unreacted nickel carbonate was filtered off and the filtrate evaporated to obtain the crystals.

$$NiCO_3 + H_2SO_4 \longrightarrow NiSO_4 + CO_2 + H_2O$$
$$NiSO_4 + 7H_2O \longrightarrow NiSO_4.7H_2O$$

Mass of one mole of $NiSO_4.7H_2O$ = 281 g
Mass of one mole of $NiCO_3$ = 119 g

(i) Calculate the mass of unreacted nickel carbonate.

Number of moles of H_2SO_4 in 40 cm^3 of 2.0 mol/dm^3 acid = 0.08

Number of moles of $NiCO_3$ reacted = ...

Mass of nickel carbonate reacted = ... g

Mass of unreacted nickel carbonate = ... g [3]

(ii) The experiment produced 10.4 g of hydrated nickel sulphate. Calculate the percentage yield.

The maximum number of moles of $NiSO_4.7H_2O$ that could be formed =

.....

The maximum mass of $NiSO_4.7H_2O$ that could be formed = ... g

The percentage yield = ... % [3]

Q# 28/ iGCSE Chemistry/2005/s/Paper 3/ QiGCSE Chemistry/201

(c) 0.015 moles of iodine react with 0.045 moles of chlorine to form 0.030 moles of a single product. Complete the equation.

I_2 + ... Cl_2 ⟶ ..... [2]

Q# 29/ iGCSE Chemistry/2005/s/Paper 3/ Q4

(d) Gypsum is hydrated calcium sulphate, $CaSO_4.xH_2O$. It contains 20.9% water by mass. Calculate x.

M_r: $CaSO_4$, 136; H_2O, 18.

79.1 g of $CaSO_4$ = ... moles

20.9 g of H_2O = ... moles

x = ... [3]

Q# 30/ iGCSE Chemistry/2004/w/Paper 3/ Q7

(c) Iron(III) sulphate decomposes when heated. Calculate the mass of iron(III) oxide formed and the volume of sulphur trioxide produced when 10.0 g of iron(III) sulphate was heated.
Mass of one mole of $Fe_2(SO_4)_3$ is 400 g.

$$Fe_2(SO_4)_3\ (s) \longrightarrow Fe_2O_3\ (s) + 3SO_3\ (g)$$

Number of moles of $Fe_2(SO_4)_3$ =	
Number of moles of Fe_2O_3 formed =	
Mass of iron(III) oxide formed =	g
Number of moles of SO_3 produced =	
Volume of sulphur trioxide at r.t.p. =	dm^3

[5]

Q# 31/ iGCSE Chemistry/2004/s/Paper 3/

3 An organic compound decomposes to form nitrogen.

$$C_6H_5N_2Cl(aq) \rightarrow C_6H_5Cl(l) + N_2(g)$$

(a) Explain the state symbols.

aq .....

l .....

g ..... [2]

Q# 32/ iGCSE Chemistry/2004/s/Paper 3/

7 Chemists use the concept of the mole to calculate the amounts of chemicals involved in a reaction.

(a) Define *mole*.

..... [1]

(b) 3.0 g of magnesium was added to 12.0 g of ethanoic acid.

$Mg + 2CH_3COOH \rightarrow (CH_3COO)_2Mg + H_2$

The mass of one mole of Mg is 24 g.

The mass of one mole of CH_3COOH is 60 g.

(i) Which one, magnesium or ethanoic acid, is in excess? You must show your reasoning.

..... [3]

(ii) How many moles of hydrogen were formed?

..... [1]

(iii) Calculate the volume of hydrogen formed, measured at r.t.p.

..... [2]

(c) In an experiment, 25.0 cm^3 of aqueous sodium hydroxide, 0.4 mol/dm^3, was neutralised by 20.0 cm^3 of aqueous oxalic acid, $H_2C_2O_4$.

$$2NaOH + H_2C_2O_4 \rightarrow Na_2C_2O_4 + 2H_2O$$

Calculate the concentration of the oxalic acid in mol/dm^3.

(i) Calculate the number of moles of NaOH in 25.0 cm^3 of 0.4 mol/dm^3 solution.

..... [1]

(ii) Use your answer to **(i)** and the mole ratio in the equation to find out the number of moles of $H_2C_2O_4$ in 20 cm^3 of solution.

..... [1]

(iii) Calculate the concentration, mol/dm^3, of the aqueous oxalic acid.

..... [2]

Q# 33/ iGCSE Chemistry/2003/w/Paper 3/ Q5

(d) Sulphur dioxide reacts with chlorine in an addition reaction to form sulphuryl chloride.

$$SO_2 + Cl_2 \longrightarrow SO_2Cl_2$$

8.0 g of sulphur dioxide was mixed with 14.2 g of chlorine. The mass of one mole of SO_2Cl_2 is 135 g.

Calculate the mass of sulphuryl chloride formed by this mixture.

Calculate the number of moles of SO_2 in the mixture = ...

Calculate the number of moles of Cl_2 in the mixture = ...

Which reagent was not in excess? .....

How many moles of SO_2Cl_2 were formed = ...

Calculate the mass of sulphuryl chloride formed = ... g [5]

Q# 34/ iGCSE Chemistry/2003/s/Paper 3/

2 Calcium and other minerals are essential for healthy teeth and bones. Tablets can be taken to provide these minerals.

(c) Each tablet contains the same number of moles of $CaCO_3$ and $MgCO_3$. One tablet reacted with excess hydrochloric acid to produce 0.24 dm^3 of carbon dioxide at r.t.p.

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$$
$$MgCO_3 + 2HCl \rightarrow MgCl_2 + CO_2 + H_2O$$

(i) Calculate how many moles of $CaCO_3$ there are in one tablet.

number of moles CO_2 = ...

number of moles of $CaCO_3$ and $MgCO_3$ = ...

number of moles of $CaCO_3$ = ...

[3]

(ii) Calculate the volume of hydrochloric acid, 1.0 mol / dm^3, needed to react with one tablet.

number of moles of $CaCO_3$ and $MgCO_3$ in one tablet = ...
Use your answer to **(c)(i)**.

number of moles of HCl needed to react with one tablet = ...

volume of hydrochloric acid, 1.0 mol / dm^3, needed to react with one tablet = ...

[2]

Q# 35/ iGCSE Chemistry/2002/w/Paper 3/ Q3

(f) Sodium reacts with sulphur to form sodium sulphide.

$$2Na + S \rightarrow Na_2S$$

An 11.5 g sample of sodium is reacted with 10 g of sulphur. All of the sodium reacted but there was an excess of sulphur.
Calculate the mass of sulphur left unreacted.

(i) Number of moles of sodium atoms reacted = ...
[2 moles of Na react with 1 mole of S]

(ii) Number of moles of sulphur atoms that reacted = ...

(iii) Mass of sulphur reacted = ...g

(iv) Mass of sulphur left unreacted = ...g [4]

Q# 36/ iGCSE Chemistry/2002/w/Paper 3/ Q3

(b) The following compounds contain two elements. Predict their formulae.

aluminium sulphide .....

silicon phosphide ..... [2]

Q# 37/ iGCSE Chemistry/2002/s/Paper 3/ Q5

(c) A 20 cm^3 sample of butyne, C_4H_6, is burnt in 150 cm^3 of oxygen. This is an excess of oxygen.

$$2C_4H_6(g) + 11O_2(g) \longrightarrow 8CO_2(g) + 6H_2O(l)$$

(i) What volume of oxygen reacts?

.....[1]

(ii) What volume of carbon dioxide is produced?

.....[1]

(iii) What is the total volume of gases left at the end of the reaction?

.....[1]

(d) Calculate the mass of water formed when 9.0 g of butyne is burnt. The mass of one mole of butyne is 54 g.

from the above equation, 1 mole of butyne forms 3 moles of water

number of moles of butyne reacted .....

number of moles of water formed .....

mass of water formed ..... g [3]

Q# 38/ iGCSE Chemistry/2001/w/Paper 3/ Q2

(c) Potassium chlorate, which has a formula of the type, $KClO_n$, decomposes to form oxygen. 2.45 g of the chlorate produced 1.49 g of potassium chloride and 0.72 dm^3 of oxygen at r.t.p. Find the value of n.

$$KClO_n \rightarrow KCl + \frac{n}{2}O_2$$

Mass of one mole of KCl = 74.5 g

Number of moles of KCl formed = ...

Number of moles of oxygen molecules formed = ...

Number of moles of oxygen atoms = ...

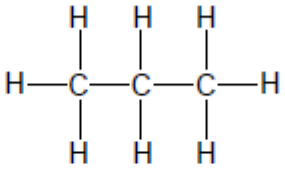
Mole ratio KCl : O is .....

n = ...

[4]

Q# 39/ iGCSE Chemistry/2001/w/Paper 3/

3 Propane is an alkane. It has the structural formula:



(a) The equation for the complete combustion of propane is given below. Insert the two missing volumes.

$$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$$

volume of gas/cm^3 .... 15 [2]

Mark Scheme

Q# 1/ iGCSE Chemistry/2015/w/Paper 31/

Question	Answer	Marks
5(a)(i)	adds up to 100%;	1
5(a)(ii)	**M1** 55.85/12 **and** 6.97(/1) **and** 37.2/16; **or** evaluation 4.650 6.970 2.325; **M2** C_2H_3O; correct answer with no working = [2]	1 1
5(a)(iii)	**M1** (86/)43; **M2** $C_4H_6O_2$; correct answer with no working = [2]	1 1

Q# 2/ iGCSE Chemistry/2015/s/Paper 31/ Q3

Question	Answer	Marks	Guidance
3(d)	M1 moles of HC*l* = 0.1(mol); M2 moles of Zn = 0.05(mol); mass of zinc = 3.25g;	3	**A** ECF for M1 × ½ **A** ECF for M2 × 65 Unit required for M3

Q# 3/ iGCSE Chemistry/2014/s/Paper 31/ Q6

(d) number of moles of O_2 formed = 0.096/24 = 0.004 (1)
number of moles of H_2O_2 in 40cm^3 of solution = 0.004 × 2 = 0.008 (1)

concentration of the hydrogen peroxide in mol/dm^3 = 0.008/0.04 = 0.2 (1) [3]

Q# 4/ iGCSE Chemistry/2013/w/Paper 31/ Q4

(d) number of moles of HCl in 40 cm^3 of hydrochloric acid,
concentration 2.0mol / dm^3 = 0.04 × 2.0 = 0.08 [1]
maximum number of moles of CO_2 formed = 0.04 [1]
mass of one mole of CO_2 = 44 g [1]
maximum mass of CO_2 lost = 0.04 × 44 = 1.76 g [1]

Q# 5/ iGCSE Chemistry/2013/w/Paper 31/ Q6

(c) number of moles of CO_2 formed = 2.112 / 44 = 0.048 [1]
number of moles of H_2O formed = 0.432 / 18 = 0.024 [1]

x = 2 and y = 1 **NOT**: ecf from this line

formula is $2PbCO_3.Pb(OH)_2$ / $Pb(OH)_2.2PbCO_3$ [1]

Q# 6/ iGCSE Chemistry/2013/s/Paper 31/ Q6

(c) $2NH_3 + NaClO \rightarrow N_2H_4 + NaCl + H_2O$ [2]
not balanced only 1

Q# 7/ iGCSE Chemistry/2013/s/Paper 31/ Q3

(b) experiment 1 $Ca^{2+} + CO_2 + H_2O$ [1]

Q# 8/ iGCSE Chemistry/2012/w/Paper 31/ Q7

(c) number of moles of HCl used = 0.05 × 2 = 0.1 [1]
number of moles of $SrCl_2.6H_2O$ which could be formed. = 0.05 [1]
mass of one mole of $SrCl_2.6H_2O$ is 267 g
theoretical yield of $SrCl_2.6H_2O$ = 0.05 × 267 = 13.35 g [1]
percentage yield = 6.4 / 13.35 × 100 = 47.9% [1]
accept: 48%
allow: ecf

Q# 9/ iGCSE Chemistry/2012/w/Paper 31/ Q2

(c) BrF_3 / F_3Br; [1]
BrF_5 / F_5Br; [1]

Q# 10/ iGCSE Chemistry/2012/s/Paper 31/

(b) moles of Fe = 51.85/56 = 0.926 (0.93); [1]
moles of O = 22.22/16 = 1.389 (1.39); [1]
moles of H_2O = 16.67/18 = 0.926 (0.93); [1]

if given as 0.9 1.4 0.9
three of the above correct = [2]
two of the above correct = [1]

simplest whole number mole ratio Fe : O : H_2O is 2: 3: 2 / $Fe_2O_3.2H_2O$; [1]
allow: ecf for a formula based on an incorrect whole number ratio

Q# 11/ iGCSE Chemistry/2012/s/Paper 31/

6 **(a)** 10 cm^3; [1]
65 cm^3; [1]

Q# 12/ iGCSE Chemistry/2011/w/Paper 31/ Q7

(c) calculation:
M_r for $NaHCO_3$ = 84 g; M_r for Na_2O = 62 g; M_r for NaOH = 40 g
M_r for Na_2CO_3 = 106 g

(i) number of moles of $NaHCO_3$ used = 3.36/84 = 0.04 [1]

(ii) if residue is Na_2O, number of moles of Na_2O = 2.12/62
=0.034 / 0.03

if residue is NaOH, number of moles of NaOH = 2.12/40
= 0.053 / 0.05

if reside is Na_2CO_3, number of moles of Na_2CO_3 = 2.12/106 =0.02 all three correct [2]
note: two correct = 1

(iii) equation 3 [1]
mole ratio 2:1 agrees with equation [1]

Q# 13/ iGCSE Chemistry/2011/s/Paper 31/ Q5 (d)

(iii) 1.33 / 1.3 / 1.3333 (mol/dm^3) scores both marks [2]
not 1.34
for a correct method – $M_1 V_1$ / moles of NaOH = 0.02
with an incorrect answer **only** [1]

Q# 14/ iGCSE Chemistry/2010/w/Paper 31/ Q5

(b) number of moles of HCl used = 0.04 × 2 = 0.08
number of moles $CoCl_2$ formed = 0.04
number of moles $CoCl_2.6H_2O$ formed = 0.04
mass of one mole of $CoCl_2.6H_2O$ = 238 g
maximum yield of $CoCl_2.6H_2O$ = 9.52g [4]
accept 9.5 g
mark ecf to moles of HCl
do **not** mark ecf to integers

to show that cobalt(II) carbonate is in excess

number of moles of HCl used = 0.08 must use value above **ecf**
mass of one mole of $CoCO_3$ = 119g
number of moles of $CoCO_3$ in 6.0g of cobalt(II) carbonate = 6.0/119 = 0.050 [1]
reason why cobalt(II) carbonate is in excess 0.05 > 0.08/2 [1]

Q# 15/ iGCSE Chemistry/2010/s/Paper 31/ Q7

(e) **(i)** percentage of oxygen = 31.6% [1]

(ii) calculate the number of moles of atoms for each element

number of moles of Ti = 31.6/48 = 0.66

number of moles of O = 31.6/16 = 1.98 **accept** 2 [1]
both correct for one mark

(iii) the simplest <u>whole number ratio</u> for moles of atoms:

Fe	:	Ti	:	O
1		1		3

[1]

(iv) formula is $FeTiO_3$ **accept** $TiFeO_3$ [1]
must be whole numbers from **(iii)** or cancelled numbers from **(iii)**
mark **ecf** throughout

Q# 16/ iGCSE Chemistry/2009/w/Paper 3/ Q6

(c) number of moles of $FeSO_4$ used = 9.12/152 = 0.06 [1]
number of moles of Fe_2O_3 formed = 0.03* [1]
mass of one mole of Fe_2O_3 = 160 g [1]
mass of iron(III) oxide formed = 0.03 × 160 = 4.8 g [1]
number of moles of SO_3 formed = 0.03 [1]
volume of sulfur trioxide formed = 0.03 × 24 = 0.72 dm^3 [1]
If mass of iron(III) oxide greater than 9.12 g, then only marks 1 and 2 available

Apply **ecf** to number of moles of Fe_2O_3* when calculating volume of sulfur trioxide.
Do not apply **ecf** to integers

Q# 17/ iGCSE Chemistry/2009/s/Paper 31/

9 **(a)** 72/24 = 3 and 28/14 = 2 [1]
Mg_3N_2 [1]
accept just formula for [2] even with incorrect or no working
NOT ecf

(b) $Al_4C_3 + 12H_2O = 4Al(OH)_3 + 3CH_4$ [2]
For Al_4C_3 ONLY [1]

(c) **(i)** silicon is limiting reagent [1]
0.07 moles of Si and 25/160 = 0.156 moles of Br_2 [1]
because 0.14 (2 × 0.07) < 0.156 [1]
If 80 used to find moles of Br_2 the mark 1 and 3 still available
arguments based on masses can be used

(ii) 0.07 [1]
NOT ecf

Q# 18/ iGCSE Chemistry/2008/w/Paper 31/ Q4

(b) **(i)** 7.7% [1]

(ii) for any number: equal number ratio [2]
for example 1:1 **or** 6:6

(iii) empirical formula is CH [1]
molecular formula is C_6H_6 [1]
no e.c.f., award of marks not dependent on **(ii)**

Q# 19/ iGCSE Chemistry/2008/w/Paper 31/ Q3

(c) **(i)** 196 [1]

(ii) 112/196 × 100 [1]
= 57(.1)% **ACCEPT** 57 to nearest whole number [1]
mark **e.c.f.** to **(c)(i)** provided percentage not greater than 100%
ONLY ACCEPT 112/answer **(c)(i)** × 100
otherwise [0]

Q# 20/ iGCSE Chemistry/2008/w/Paper 31/

7 **(a)** **(i)** $35cm^3$ [1]
$40cm^3$ [1]

Q# 21/ iGCSE Chemistry/2008/s/Paper 31/ Q7

(b) number of moles of NaOH used = 0.025 x 2.24 = 0.056 [1]

maximum number of moles of $Na_2SO_4.10H_2O$ that could be formed = 0.028 [1]

mass of one mole of $Na_2SO_4.10H_2O$ = 322g

maximum yield of sodium sulphate – 10 - water = 9.02g [1]

percentage yield = 42.8% [1]
mark **ecf** but NOT to simple integers
if **ecf** marking, mark to at least one place of decimals
if percentage > 100% then 3/4 maximum

Q# 22/ iGCSE Chemistry/2007/w/Paper 3/ Q7 (b)

(ii) mass of one mole of $CaCO_3$ = 100
number of moles of $CaCO_3$ = 0.3/100 = 0.003 [1]
moles of HCl = 5/1000 x 1 = 0.005 [1]
reagent in excess is $CaCO_3$ [1]
ecf from above
would need 0.006 moles of HCl
or hydrochloric acid only reacts with 0.0025 moles of $CaCO_3$ [1]
NOTE this mark needs to show recognition of the 1:2 ratio

(iii) mark **ecf** to **(ii)**, that is from moles of limiting reagent in **(ii)**
moles of CO_2 = 0.005 x 0.5 x 24 = 0.06 dm^3 [1]
NOT cm^3 unless numerically correct. 60 cm^3
Ignore other units
NOTE If both number of moles integers then no ecf for **(ii)** and **(iii)**

Q# 23/ iGCSE Chemistry/2008/s/Paper 31/ Q7

(d) 100g of fat react with 86.2g of iodine
884g of fat react with **762** g of iodine [1]
limit 762 x 2
one mole of fat reacts with 762/254 moles of iodine molecules
one mole of fat reacts with **3** moles of iodine molecules [1]

number of double bonds in one molecule of fat is **3** [1]
limit 6
consequential marking allowed provided the number of double bonds is an integer.

Q# 24/ iGCSE Chemistry/2006/w/Paper 3/ Q3

(b) **(i)** 100 [1]
56 ignore units in both cases [1]

(ii) 7.00kg is 1/8 of 56 [1]
1/8 of 100kg is 12.5kg [1]
Give both marks for correct answer without explanation. Ignore missing units but penalise wrong units

Q# 25/ iGCSE Chemistry/2006/w/Paper 3/

6 (a)

	copper	iron	sulphur	
composition by mass/g	(4.80)	(4.20)	4.8	[1]
number of moles of atoms	0.075	0.075	0.15	[1]
simplest mole ratio of atoms	1	1	2	[1]

[3]

The empirical formula is $CuFeS_2$ [1]

Q# 26/ iGCSE Chemistry/2006/s/Paper 3/ Q7

(d) moles of CH_3-CH = CH_2 reacted = 1.4/42 = 0.033 **[1]**
conseq
maximum moles of CH_3-$CH(I)$-CH_3 that could be formed = 0.033 **[1]**
conseq
maximum mass of 2-iodopropane that could be formed = 5.61 g **[1]**
accept 170 x 0.033 = 5.61 and 170 x 0.033333 = 5.67
conseq unless greater than 100%
percentage yield 4.0/5.67 x 100 = 70.5% **[1]**
Do not mark consequently to a series of small integers. There has to be a serious attempt to answer the question, then consequential marking is appropriate.

Q# 27/ iGCSE Chemistry/2005/w/Paper 3/

Question 6

(a)(i) moles of $NiCO_3$ reacted = 0.08 **[1]**
mass of nickel carbonate reacted = 9.52 g **[1]**
mass of nickel carbonate unreacted = 2.48 g **[1]**

(ii) maximum number of moles of hydrated salt = 0.08 **[1]**
maximum mass of salt = 0.08 x 281 = 22.48 g **[1]**
percentage yield 10.4/22.48 x 100 = 46.3% **[1]**

Q# 28/ iGCSE Chemistry/2005/s/Paper 3/ QiGCSE Chemistry/201

(c) $I_2 + 3Cl_2 = 2ICl_3$ **[2]**
For having either reactants **or** products correct ONLY [1]

Q# 29/ iGCSE Chemistry/2005/s/Paper 3/ Q4

(d) mass of one mole of $CaSO_4$ = 136
moles of $CaSO_4$ in 79.1g = 0.58 accept 0.6 **[1]**
moles of H_2O in 20.9 g = 1.16 accept 1.2 **[1]**
conseq x = 2 x given as an integer **[1]**

Q# 30/ iGCSE Chemistry/2004/w/Paper 3/ 7 (c)

Mark consequentially to any error **but not involving simple integers**
There has to be some evidence that the candidate has attempted to work through the calculation and not merely inserted whole numbers.
For example 2, 1, 160 or 1, 0.5, 80
number of moles of $Fe_2(SO_4)_3$ = 1/40 **or** 0.025
number of moles of Fe_2O_3 formed = 1/40 **or** 0.025
mass of iron(III) oxide formed = 0.025 x 160 = 4g
number of moles of SO_3 produced = 3/40 **or** 0.075
volume of sulphur trioxide at r.t.p. = 0.075 x 25
= 1.8dm^3 **[5]**

Q# 31/ iGCSE Chemistry/2004/s/Paper 3/

3. **(a)** dissolved **or** solution in water **[1]**
NOT aqueous **NOT** soluble in water
l liquid and g gas **[1]**

Q# 32/ iGCSE Chemistry/2004/s/Paper 3/

7 (a) Avogadro's Number of particles
or formula mass in grams
or 6×10^{23} particles accept atoms, ions and molecules
or as many particles as there are carbon atoms in 12.00g of ^{12}Ca
ANY one [1]

(b) (i) moles of Mg = 3/24 = 0.125
moles of CH_3COOH = 12/60 = 0.200
magnesium is in excess

OR 3.0g of magnesium react with 15g of acid
only 12.0 g of acid present
magnesium is in excess [3]

(ii) **Mark conseq to (i) but NOT to any simple integer**
moles of H_2 = 0.1 [1]

(iii) **Mark conseq to (ii) but NOT to any simple integer**
Volume of hydrogen = 0.1 x 24
= 2.4 dm^3 [2]

(c) (i) moles of NaOH = 25/1000 x 0.4 = 0.01 [1]

(ii) **Mark conseq to (i) but NOT to any simple integer**
moles of acid = 0.01/2 = 0.005 [1]

(iii) **Mark conseq to (ii) max 10M**
concentration of acid = 0.005 x 1000/20 [1]
= 0.25 mol/dm^3 [1]

Q# 33/ iGCSE Chemistry/2003/w/Paper 3/ Q5

(d) the number of moles of SO_2 in the mixture = 0.125
the number of moles of Cl_2 in the mixture = 0.2
cond reagent was not in excess? SO_2
cond moles of SO_2Cl_2 formed = 0.125
cond the mass of sulphuryl chloride formed = 16.9g
[5]

Q# 34/ iGCSE Chemistry/2003/s/Paper 3/ Q2

(c) (i) number of moles CO_2 = 0.24/24 = 0.01
conseq number of moles of $CaCO_3$ and $MgCO_3$ = 0.01
conseq number of moles of $CaCO_3$ = 0.005 [3]

(ii) Calculate the volume of hydrochloric acid, 1.0 $mole/dm^3$, needed to react with one tablet.
number of moles of $CaCO_3$ and $MgCO_3$ in one tablet = 0.01
Expect same as answer to (c)(i). NO marks to be awarded. Just mark consequentially to this response
conseq number of moles of HC*l* needed
to react with one tablet = 0.02 [1]

conseq volume of hydrochloric acid, 1.0 $mole/dm^3$, needed to react with one tablet = 0.02 dm^3 or 20 cm^3 [1]

Q# 35/ iGCSE Chemistry/2002/w/Paper 3/ Q3

(f) (i) 11.5/23 = 0.5 [1]

(ii) 0.25 [1]
conseq to (i)

(iii) 0.25 x 32 = 8 g [1]
conseq

(iv) 2.0 g [1]
only **conseq** to (iii) if answer to (iii) is less than 10

NB If (ii) is 0.3(125), no excess is possible, (iv) **ZERO**

Q# 36/ iGCSE Chemistry/2002/w/Paper 3/ Q3

(b) Al_2S_3 [1]
Si_3P_4 [1]

Q# 37/ iGCSE Chemistry/2002/s/Paper 3/ Q5 (c)

(i) 110 (cm3)
(ii) 80 (cm3)
(iii) Starting gases (170) of which 130 was used, so 40 left of O2, 80 made of CO2 and H2O is a liquid therefore 80

(d)
0.167
0.5 mol water
9g of water
3 marks

Q# 38/ iGCSE Chemistry/2001/w/Paper 3/ Q2

(c) *0.02 [1]
0.03 **not conseq** [1]
*0.06 **conseq to above** [1]
3 accept either as ratio or on n = [1]
Accept ratio conseq to answers designated by *

Q# 39/ iGCSE Chemistry/2001/w/Paper 3/

3 (a) 5 [1]
25 [1]

Group																	
I	II										III	IV	V	VI	VII	0
							1 H Hydrogen 1									4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4										11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12										27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

*58–71 Lanthanoid series
†90–103 Actinoid series

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	163 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

Key: a X b — a = relative atomic mass; X = atomic symbol; b = proton (atomic) number

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).